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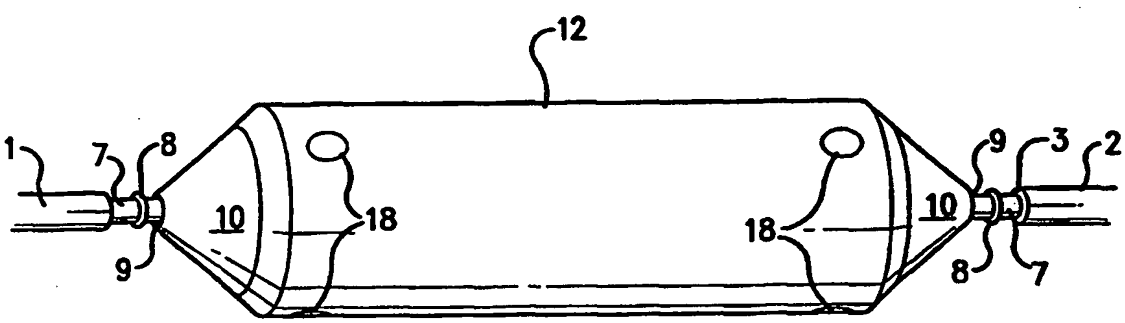


(57) Abstract

A submarine fiber–optic cable joint is provided with a load–bearing casing (12) for use with unarmored fiber–optic cables (1, 2). The device includes first and second terminating socket assemblies (11) for terminating the strength members (6) of a first and second fiber–optic cable respectively (1, 2). The optical fibers (19) of the two cables are spliced together and are stored in a fiber storage tray (23) that slidably engages the terminating socket assemblies (11). A cylindrical steel casing (12) encloses the fiber storage tray (23) and is attached to the first and second terminating socket assemblies (11) by fasteners. By slidably engaging the terminating socket assemblies (11) while the terminating socket assemblies remain fixed with respect to the casing (12), the fiber storage tray (23) is non–load–bearing. Thus, when a load is placed on one of the cables connected to the cable joint, the load is transferred to the other cable through the steel casing (12). As a result, little or no load passes through the fiber storage tray (23).

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# Submarine Fiber-Optic Cable Joint With Load-Bearing Casing

## Field of the Invention

In our truly global society, more and more people are becoming interconnected with one another through telecommunications systems. Although submarine fiber-optic cable communications systems are but one type of telecommunication system, submarine fiber-optic cables are capable of carrying a greater number of data and voice transmissions than traditional submarine cable systems or modern satellite communication systems.

Stretching thousands of miles across the oceans, submarine fiber-optic cables lie on the ocean's floor, thousands of feet below sea level. Because no one cable could be made that extended thousands of miles in length, submarine fiber-optic cable communication systems are comprised of a series of submarine fiber-optic cables that are spliced together at cable joints. In this manner, many individual cables can be connected to form a single cable of the required length.

If one were to cut open a standard "unarmored" fiber-optic cable, he would see that each cable is comprised of a series of optic fibers clustered around a steel "king" wire. Together, these wires form the fiber-optic "core" of the cable. The fiber-optic core itself is surrounded by



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steel strength members and two watertight, insulating jackets (an inner copper jacket and an outer polyethylene jacket) encase the entire assembly. The function of the optic fibers is to carry the data and voice transmissions sent over the fiber-optic cable; the steel wires carry any loads placed upon the cable and, in conjunction with the insulating jackets, give the cable its rigidity. Because excess residual strain on the optic fibers may result in undesirable static fatigue and crack growth in the fibers, it is important that the amount of permanent load on the optic fibers (i.e., sustained loads over long periods of time) be minimized. Minimizing the amount of permanent load will prevent excess residual strain from developing in the optic fibers and thus will protect the fibers from damage. Accordingly, it is important that the optic fibers of a fiber-optic cable be protected against permanent loading and excess residual strain.

The cable joints themselves, however, are subject to a considerable amount of potentially harmful loads. One of the largest loads placed on the cable joints is caused by the fiber-optic cables themselves. For example, when a cable is being lowered to or raised from the ocean floor, a large tension load is created in the cable by the weight of the many thousands of feet of additional cable below it and this load is transferred to the cable joint. In addition, once the cable reaches the desired location, the hydrostatic pressure at that depth can create upwards of 10,000 psi of compression on the cable joint. Because any one of these loads could result in an expensive failure in the fiber-optic cable communication system, it has always been a priority to design cable joints in such a way that when a load is placed upon one cable, the load can be successfully transferred to the other cable without putting stress on the interconnected optic fibers of the two cables.

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The cable joints used to connect two cables together were traditionally formed by "terminating" the two cables in separate terminating sockets and securely connecting the two terminating sockets with a load-bearing fiber storage tray or cylinder. The individual optic fibers of the cables were then spliced together and secured in the storage tray and the entire subassembly was covered with a steel jacket and insulated with heat-shrink insulation to make the cable joint waterproof.

Cable terminating technology is well-known in the prior art. The idea behind cable terminating is to secure the load-bearing steel members of the fiber optic cable, including both the steel strength members and the steel king wire, to a terminating socket so that any load placed on the steel members would be transferred to the terminating socket. The fragile optic fibers of the cable, however, would completely pass through the terminating socket.

Typically one terminates a fiber-optic cable by stripping off the cable's insulating jackets, separating the steel strength members from the fiber-optic core, and slipping both the strength members and the core through the center of the terminating socket. A copper jacket and a steel plug are then placed over the core and the steel plug is firmly wedged into the terminating socket. In this way, the steel strength members are secured against the interior surface of the terminating socket, while the fiber-optic core passes freely through the socket. To terminate the steel king wire, one merely needs to separate the individual optic fibers from the king wire and to attach the king wire to a king wire clamp assembly. Because the king wire clamp assembly is also connected to the terminating socket, or is connected to a load-bearing fiber storage tray that is itself attached to the terminating socket, the end result is that all load-





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bearing steel members of the fiber-optic cable are secured to a terminating socket.

In a typical cable joint, a load-bearing fiber storage tray or cylinder securely connects the two terminating sockets. In this arrangement, the fiber storage tray either connects directly to the terminating sockets or to the king wire clamp assemblies which, in turn, are connected to the terminating sockets. This configuration is intuitive because the fiber storage tray of a standard cable joint is in longitudinal alignment with both fiber-optic cables. Given these conditions, if one were to attach the storage tray firmly to both terminating sockets, any force acting on one component of the assembly would act upon the entire assembly. Thus, with this type of cable joint design, any load placed on the first cable is transferred to its terminating socket, through the fiber storage tray to the other terminating socket, and ultimately to the other cable. The load-bearing fiber storage tray is usually connected to the terminating sockets by fasteners such as pins, screws, bolts, locking rings, threaded assemblies, or welds.

The disadvantage of this configuration, however, is that the load-bearing fiber storage tray or cylinder used in the cable joint must be of sufficient mass and strength to resist any loads that pass through it. Thus, such a component is usually quite bulky and is made out of hardened steel. Furthermore, due to the strength that must be built into load-bearing fiber storage trays, fiber-to-fiber connections (i.e., two optic fibers spliced together) are usually stored on only one side of the tray; the structural integrity of the storage tray may be compromised if both sides of the tray are channeled out so as to accommodate traditional fiber-storing methods. Using only one side of the storage tray, however, decreases the total amount of the fiber-to-fiber splices



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that can be stored in the fiber storage tray.

Summary of the Invention

In light of the above, it is an object of the present invention to provide a submarine fiber-optic cable joint with a load-bearing casing for use with fiber-optic cables. In particular, this invention is designed to be used with unarmored fiber-optic cables, although it may readily be adapted for use with armored cables as well.

It is a further object of the present invention to provide a submarine fiber-optic cable joint for connecting two cables wherein any load that is placed on one cable is transferred to the other cable without having the fiber storage tray bear a substantial load.

It is an additional object of the present invention to provide a submarine fiber-optic cable joint with terminating socket assemblies, comprised of the terminating sockets and the king wire clamp assemblies (if the fiber-optic cable has a king wire) or end plate assemblies (if the fiber-optic cable does not have a king wire or if the king wire clamp assembly is otherwise unnecessary), wherein the fiber storage tray slidably engages the terminating sockets assemblies. By slidably engaging the terminating socket assemblies while the terminating socket assemblies remain fixed with respect to the casing, the fiber storage tray is non-load-bearing (i.e., "floating").

Accordingly, it is an embodiment of the invention to provide a submarine fiber-optic cable joint with a load-bearing casing. The device includes first and second terminating socket assemblies for terminating the strength members of a first and second fiber-optic cable respectively. The optic fibers of the two cables are spliced together and are stored in a fiber storage tray that slidably engages the terminating socket assemblies.





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A cylindrical steel casing encloses the fiber storage tray and is attached to the first and second terminating socket assemblies by fasteners. In the preferred embodiment of the invention, the casing extends over a portion of the first and second terminating sockets and is attached to the terminating sockets by pins that extend through apertures in the casing and that are secured in pin chambers in the terminating sockets.

Because of this configuration, when a load is placed on one of cables connected to the cable joint, the load is transferred to the other cable through the steel casing. As a result, little or no load passes through the fiber storage tray.

Additional objects, advantages, embodiments, and novel features of the invention will be set forth in part in the description that follows, and in part will become apparent to those skilled in the art upon examination of the following or may be learned by practice of the invention.

<u>Brief Description of the Drawings</u>

The invention will be more readily understood through the following detailed description, with reference to the accompanying drawings, in which:

**FIG. 1** is a perspective view of the preferred embodiment of the invention;

**FIG. 2** is the perspective view illustrated in **Fig. 1** with the snap rivets and pins removed, and with portions of the terminating socket assemblies illustrated by dashed lines;

**FIG. 3** is an expanded perspective view of the components used in a terminating socket assembly for terminating a fiber-optic cable;

**FIG. 4** is a perspective view of a terminating socket;

**FIG. 5** is a perspective view of the fiber storage



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tray;

**FIG. 6** is a perspective view of a terminating socket assembly;

**FIG. 7** is a expanded perspective view of the fiber storage tray and a terminating socket assembly before the fiber storage tray slidably engages the terminating socket assembly;

**FIG. 8** is a perspective view of the fiber storage tray slidably engaged with a terminating socket assembly;

**FIG. 9** is a perspective view of an alternate embodiment of the terminating socket assembly, wherein the terminating socket assembly is primarily comprised of a terminating socket and an end plate assembly;

**FIG. 10** is a perspective view of the fiber storage tray slidably engaged with the terminating socket assembly illustrated in **Fig. 9**.

The dashed lines used in **Fig. 2** are meant to illustrate the relative position of the terminating socket assemblies inside the casing and are not supposed to provide a detailed depiction of the terminating socket assemblies. A terminating socket assembly comprised of a terminating socket and a king wire clamp assembly is shown in detail in **Fig. 6**.

## Description of the Preferred Embodiment

The present invention is a submarine fiber-optic cable joint with a load-bearing casing for use with fiber-optic cables. Although the present invention may be used with both armored and unarmored cables, the preferred embodiment of the invention is for use with unarmored submarine fiber-optic cables.

As seen in **Fig. 1**, the present invention will be described in connection with unarmored submarine fiber-optic cables **1** and **2**. In the preferred embodiment of the invention, the submarine fiber-optic cable joint is used



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to connect two 24-fiber fiber-optic cables for use in trans-oceanic cable operations. Before a cable is connected to the present invention, however, it is preferable that the insulating copper and polyethylene jackets **3** be stripped off, thereby revealing the cable's fiber-optic core **4** (including a steel king wire **5**) and steel strength members **6**. Each stripped cable **7** is then passed through an anti-extrusion washer **8** and is inserted into the cable entrance **9** of a terminating socket **10**.

The terminating socket assemblies **11** are partially encased by a cylindrical steel casing **12**, as illustrated in **Fig. 2**. In the preferred embodiment of the invention, each terminating socket assembly **11** is secured to the casing **12** by three steel pins **13**, although any fastening means (such as screws, bolts, clamps, locking rings, threaded assemblies, or welds) will do. The thickness of the casing **12** must be sufficient to withstand the hydrostatic pressure it is exposed to when it is on the ocean floor, and to carry any loads transferred to the casing **12** from the terminating socket assemblies **11** through the pins **13**.

The pins **13** connect the casing **12** to the terminating socket assemblies **11** by passing through pin apertures **14** in the casing **12** and engaging cylindrical pin chambers **15** in the terminating socket assemblies **11**. In the preferred embodiment of the invention, the pin chambers **15** are in the portion of the terminating socket assembly **11** comprised of the terminating socket **10**. The depth of the pin chambers **15** is designed to engage a sufficient volume of pins **13** to allow the pins **13** to restrain the terminating socket assemblies **11** when any loads are placed on the terminating socket assemblies **11**, i.e., when any loads are placed on cables **1** or **2**. The pin chambers **15**, however, must not be made too deep; if there is insufficient structure beneath the pin chambers **15**, the



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hydrostatic pressure exerted on the pins **13** might push them through the floor of the pin chambers **15** and into the terminating chamber **16** of the terminating sockets **10**.

Once the pins **13** have been inserted into the casing **12** and the terminating socket assemblies **11**, it is desirable that they stay there. Therefore, to ensure that the pins **13** will not fall out once they have been inserted, it is preferable that the pins **13** be knurled, although a threaded access hole **17** should be provided to facilitate later pin removal. Because the length of a pin **13** is less than the combined depth of a pin aperture **14** and a pin chamber **15**, snap rivets **18** are used to cover the pins **13** and to make the snap rivet/pin assembly lie flush with the outer surface of the casing **12**.

In the preferred embodiment of the invention, each pin aperture **14** and pin chamber **15** is spaced 120 degrees apart from the next pin aperture **14** or pin chamber **15**. Furthermore, it is desirable that the pin apertures **14** on each end of the casing **12** be longitudinally aligned along the length of the casing **12**.

The steel strength members **6** of stripped cables **7** are secured to the terminating sockets **10** along the surface of the terminating chamber **16** of each terminating socket **10**. The components used in conjunction with a terminating socket assembly **11** for terminating a stripped fiber-optic cable **7** are shown in **Fig. 3**. In **Fig. 3**, however, the cable **7** has not yet been secured to the surface of the terminating chamber **16**. Likewise, **Fig. 4** is a detailed perspective view of a terminating socket **10** before the cable **7** has been secured. Cable terminating technology, however, is well-known in the prior art.

The idea behind cable terminating is to secure the load-bearing steel members of a stripped fiber optic cable **7**, including both its steel strength members **6** and its steel king wire **5**, to a terminating socket assembly **11**



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(shown in **Fig. 6**) so that any load placed on the steel members is transferred to the terminating socket assembly **11**. The fragile optic fibers **19**, however, completely pass through the terminating socket assembly **11**.

With reference to **Figs. 3** and **4**, one typically terminates a fiber-optic cable **1** or **2** by stripping off the cable's insulating jackets **3**, separating the steel strength members **6** from the fiber-optic core **4**, and slipping both the strength members **6** and the core **4** through the center of the terminating socket **10**. A copper jacket **20** and a steel plug **21** are then placed over the core **4** and the steel plug **21** is firmed wedged into the terminating chamber **16**. In this way, the steel strength members **6** are secured against the surface of the terminating chamber **16**, while the fiber-optic core **4** passes freely through the socket **10**, the copper jacket **20**, and the steel plug **21**. To terminate the steel king wire **5**, one merely needs to separate the individual optic fibers **19** from the king wire **5**, pass the optic fibers **19** through a king wire clamp assembly **22**, and attach the king wire **5** to the king wire clamp assembly **22**. The king wire clamp assembly **22** is then connected to the terminating socket **10** by screws (not shown). Because the terminating socket **10** and the king wire clamp assembly **22** together comprise the preferred embodiment of the terminating socket assembly **11**, the end result of this process is that all load-bearing steel members of the fiber-optic cable **1** or **2** are secured to the terminating socket assembly **11**.

In an alternate embodiment of the invention (shown in **Fig. 9**) there is no need for a king wire clamp assembly **22**; either the fiber-optic cable **1** or **2** lacked a king wire **5**, or the king wire **5** was terminated in some other manner. In this case, an end plate assembly **24** is connected to the terminating socket **10** by screws (not shown) so that the fiber storage tray **23** can slidably engage the terminating



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socket assembly **11** (shown in **Fig. 10**). Because the terminating socket **10** and the end plate assembly **24** together comprise an alternate embodiment of the terminating socket assembly **11**, the end result of this process is that all load-bearing steel members of the fiber-optic cable **1** or **2** are secured to the terminating socket assembly **11**.

After the fiber-optic cables **1** and **2** have been terminated in terminating socket assemblies **11**, the individual optic fibers **19** of each cable **1** and **2** are connected in the desired combination. Methods of splicing optic fibers **19** together (such as recoating or mechanical splinting) are well known in the prior art. The spliced optic fibers (not shown) are then stored in a fiber storage tray **23**.

The fiber storage tray **23** is positioned between the terminating socket assemblies **11** and is completely enclosed within the casing **12**. The fiber storage tray **23**, however, is not firmly connected to the terminating socket assemblies **11**. Although it is not necessary that the fiber storage tray **23** be connected to the terminating socket assemblies **11** at all (i.e., the fiber storage tray **23** may be secured directly to the casing **12** and still be "non-load-bearing"), in the preferred embodiment of the invention the fiber storage tray **23** is loosely connected to the terminating socket assemblies **11** and thus the fiber storage tray **23** "floats" between the terminating socket assemblies **11**.

The preferred manner in which the fiber storage tray **23** is loosely connected to the terminating socket assemblies **11** is by having the fiber storage tray **23** slidably engage the terminating socket assemblies **11** (shown in **Figs. 7** and **8**). The fiber storage tray **23** is able to slidably engage the terminating socket assemblies **11** because each connection interface of the fiber storage





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tray **23** (comprised of extended locking tabs **25** and locking cut-outs **26**) longitudinally engages a connection interface of the terminating socket assemblies **11** (comprised of raised locking members **27** and locking channels **28**).

In the preferred embodiment of the invention, each connection interface has three locking tabs **25** or locking members **27** and three locking cut-outs **26** or locking channels **28**. In addition, the connection interface of the fiber storage tray **23** is 60 degrees out of phase with the connection interface of the terminating socket assemblies **11**. Because the connection interfaces has been positioned in this manner, when the fiber storage tray **23** and the terminating socket assemblies **11** are pushed together to be joined, the locking tabs **25** slidably engage the locking channels **28** and the locking members **27** slidably engage the locking cut-outs **26**. Thus, the connection interfaces function together as dual "lock and key" mechanisms for loosely connecting the fiber storage tray **23** to the terminating socket assemblies **11**.

The process by which the fiber storage tray **23** is loosely connected to the terminating socket assemblies **11** is to first slidably engage the fiber storage tray **23** to one terminating socket assembly **11**, and then to slidably engage the other terminating socket assembly **11** to the other end of the fiber storage tray **23**. After the components have been loosely connected (and the optic fibers **19** have been properly connected and spliced), the casing **12** covers the entire subassembly and the pins **13** are inserted to hold the terminating socket assemblies **11** in place.

Because the position of the terminating socket assemblies **11** has been fixed in relation to the casing **12** by the pins **13**, the distance between the end walls **29** of the terminating sockets **10**, and the distance between the end walls **30** of the terminating socket assemblies **11**, are



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both likewise fixed. With respect to the fiber storage tray **23**, the maximum length of the storage tray **23** is $d_{MAX}$ and the distance between the outside surfaces of the end walls **31** of the storage tray **23** is $d_{MIN}$ (see **Fig. 5**).

To ensure a loose connection between the fiber storage tray **23** and the terminating socket assemblies **11**, the distance between the end walls **29** of the terminating sockets **10** is slightly larger than $d_{MAX}$ and the distance between the end walls **30** of the terminating socket assemblies **11** is slightly larger than $d_{MIN}$. Also, the width of the locking cut-outs **26** is slightly greater than the width of the locking members **27**, the width of the locking tabs **25** is slightly less than the width of the locking channels **28**, and the length of the locking members **27** is slightly less than the depth of the locking cut-outs **26**.

It is desirable, however, that once the terminating socket assemblies **11** and the fiber storage tray **23** are assembled, they remain so. Thus, in order to make sure that the fiber storage tray **23** and the terminating socket assemblies **11** remain loosely connected and do not disengage, the distance between the end walls **30** of the terminating socket assemblies **11** is less than $d_{MAX}$. Also, rubber O-rings (not shown) are used between the terminating socket assemblies **11** and the fiber storage tray **23** to reduce the longitudinal movement of the storage tray **23** in relation to the terminating socket assemblies **11**.

By "floating" between the terminating socket assemblies **11**, the fiber storage tray **23** is non-load-bearing. Thus, if any load is placed on the terminating socket assemblies **11** (i.e., through the cables **1** or **2**), little or no load will be transferred to the fiber storage tray **23**. Instead, the fixed nature of the terminating socket assemblies **11** in relation to the casing **12** guarantees that any load will be transferred from one





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socket assembly **11** to the other through the casing **12** and pins **13**. Because the storage tray **23** "floats" and is not in firm contact with either the terminating socket assemblies **11** or the casing **12**, it does not transfer any compressive, tensile, or rotational loads.

Although a fiber storage tray **23** is used in conjunction with this invention, alternate embodiments of the invention may include using fiber storage cylinders or "loose-fit" storage means for storing the spliced optic fibers (not shown). Likewise, the cylindrical nature of the casing **12** is not an essential feature of this device; the casing **12** could be of almost any shape. The cylindrical nature of the casing **12**, however, is preferable because it makes application of heat-shrink insulation (not shown) over the casing **12** easier.

In the preferred embodiment of the invention, the terminating socket assemblies **11**, the pins **13**, and the casing **12** are all made out of high-strength steel. Because the fiber storage tray **23** is not a load-bearing component, it is preferably made out of aluminum, although it could be made out of molded plastic as well. Furthermore, the fact that little or no loads pass through the storage tray **23** means that it is not essential that the storage tray **23** be thick in order to maintain its structural integrity. Therefore, both sides of the storage tray **23** may be used to store fiber-to-fiber connections without fear that the storage tray **23** would be substantially weakened by using both sides. In the preferred embodiment of the invention, only one side of the storage tray **23** is used to store splices, but this is only because there is adequate space on one side of the tray to store the 24 spliced optic fibers that accompany a standard fiber-optic cable. If the cables **1** or **2** each contain more than 24 optic fibers **19** (i.e., 48 each), it may be preferable to use both sides of the fiber storage





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tray **23** to store the spliced optic fibers.

Still other objects and advantages of the present invention will become readily apparent to those skilled in this art from the above-recited detailed description, wherein only the preferred embodiment of the invention has been shown and described. The description of the preferred embodiment is simply by way of illustration of the best mode contemplated for carrying out the invention. As will be realized, the invention is capable of other and different embodiments, and its several details are capable of modification in various respects, all without departing from the invention. Accordingly, the drawings and descriptions are to be regarded as illustrative in nature, and not as restrictive.





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I claim:

1. A fiber-optic cable joint for connecting fiber-optic cables, comprising:
   a. a first terminating socket assembly for terminating a substantial number of the strength members of a first fiber-optic cable;
   b. a second terminating socket assembly for terminating a substantial number of the strength members of a second fiber-optic cable;
   c. a fiber storage tray, positioned between said first terminating socket assembly and said second terminating socket assembly, wherein optic fibers of said first fiber-optic cable are connected to optic fibers of said second fiber-optic cable;
   d. a casing, having a first end and a second end, for enclosing said fiber storage tray;
   e. a first fastener for connecting said first end of said casing to said first terminating socket assembly;
   f. a second fastener for connecting said second end of said casing to said second terminating socket assembly; and
   g. wherein a substantial portion of any load place on said first fiber-optic cable is transferred to said second fiber-optic cable through said first terminating socket assembly, said first fastener, said casing, said second fastener, and said second terminating socket assembly.

2. The device as recited in claim 1, wherein said fiber storage tray slidably engages said first terminating socket assembly and said second terminating socket assembly.





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3. A cable joint for connecting fiber-optic cables comprising:
   a. a first terminating socket assembly for terminating a substantial number of the strength members of a first fiber-optic cable;
   b. a second terminating socket assembly for terminating a substantial number of the strength members of a second fiber-optic cable;
   c. a fiber storage tray, positioned between said first terminating socket assembly and said second terminating socket assembly, wherein optic fibers of said first fiber-optic cable are connected to optic fibers of said second fiber-optic cable;
   d. a casing for enclosing said fiber storage tray;
   e. first connecting means for connecting said casing to said first terminating socket assembly;
   f. second connecting means for connecting said casing to said second terminating socket assembly; and
   g. wherein a substantial portion of any load place on said first fiber-optic cable is transferred to said second fiber-optic cable through said first terminating socket assembly, said first connecting means, said casing, said second connecting means, and said second terminating socket assembly.

4. The device as recited in claim 3, wherein said fiber storage tray engages said first terminating socket assembly and said second terminating socket assembly.

5. A fiber-optic cable joint for connecting fiber-optic cables, comprising:



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a. a first terminating socket assembly for terminating the strength members of a first fiber-optic cable, said first terminating socket assembly defining a first pin chamber;

b. a second terminating socket for terminating the strength members of a second fiber-optic cable; said second terminating socket assembly defining a second pin chamber;

c. a fiber storage tray, positioned between said first terminating socket assembly and said second terminating socket assembly, wherein optic fibers of said first fiber-optic cable are connected to optic fibers of said second fiber-optic cable;

d. a casing, having a first end and a second end, for enclosing said fiber storage tray, said casing defining a first pin aperture proximate said first end and a second pin aperture proximate said second end;

e. a first pin for connecting said casing to said first terminating socket assembly, a portion of said first pin passing through said first pin aperture and engaging said first pin chamber;

f. a second pin for connecting said casing to said second terminating socket assembly, a portion of said second pin passing through said second pin aperture and engaging said second pin chamber; and

g. wherein a substantial portion of any load place on said first fiber-optic cable is transferred to said second fiber-optic cable through said first terminating socket assembly, said first pin, said casing, said second pin, and said second terminating socket assembly.

6. The device as recited in claim 5, wherein said fiber storage tray slidably engages said first terminating socket assembly and said second terminating socket assembly.



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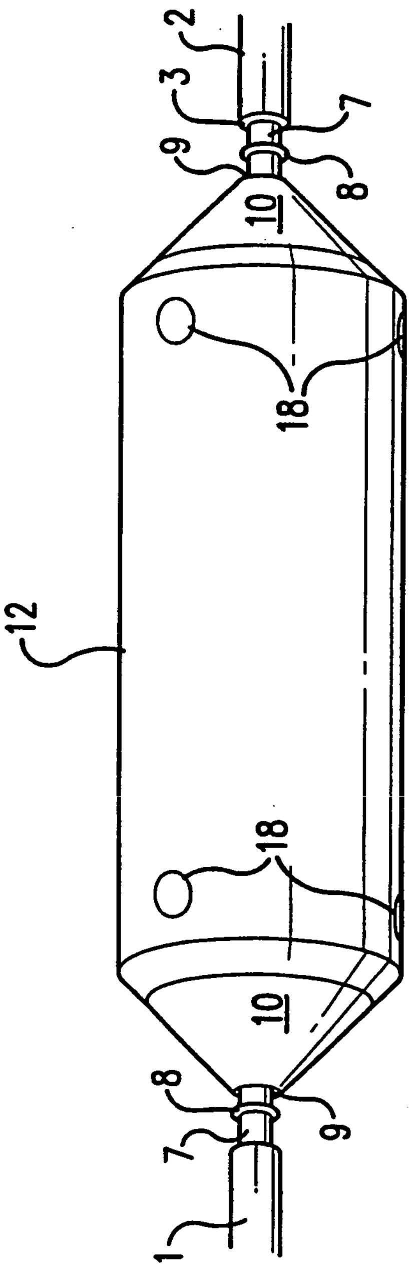


FIG. 1



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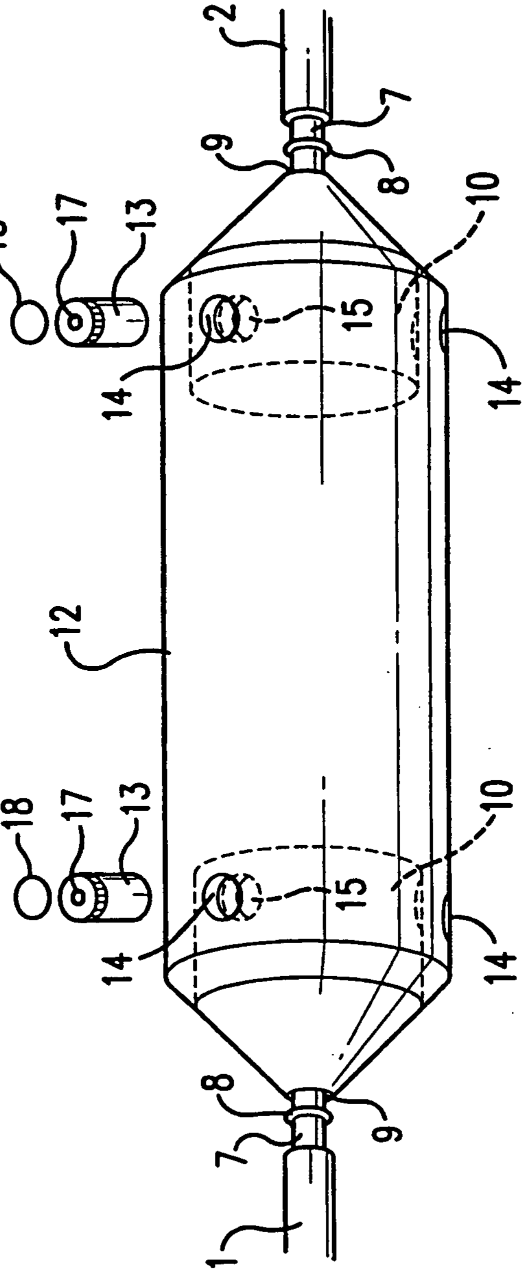


FIG. 2



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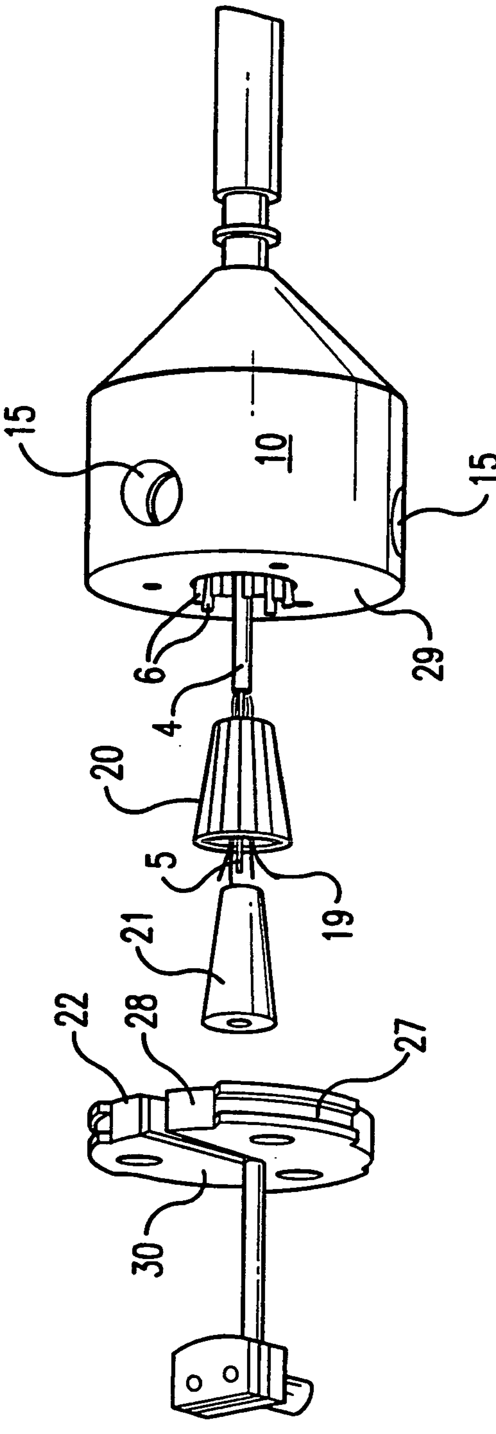


FIG. 3

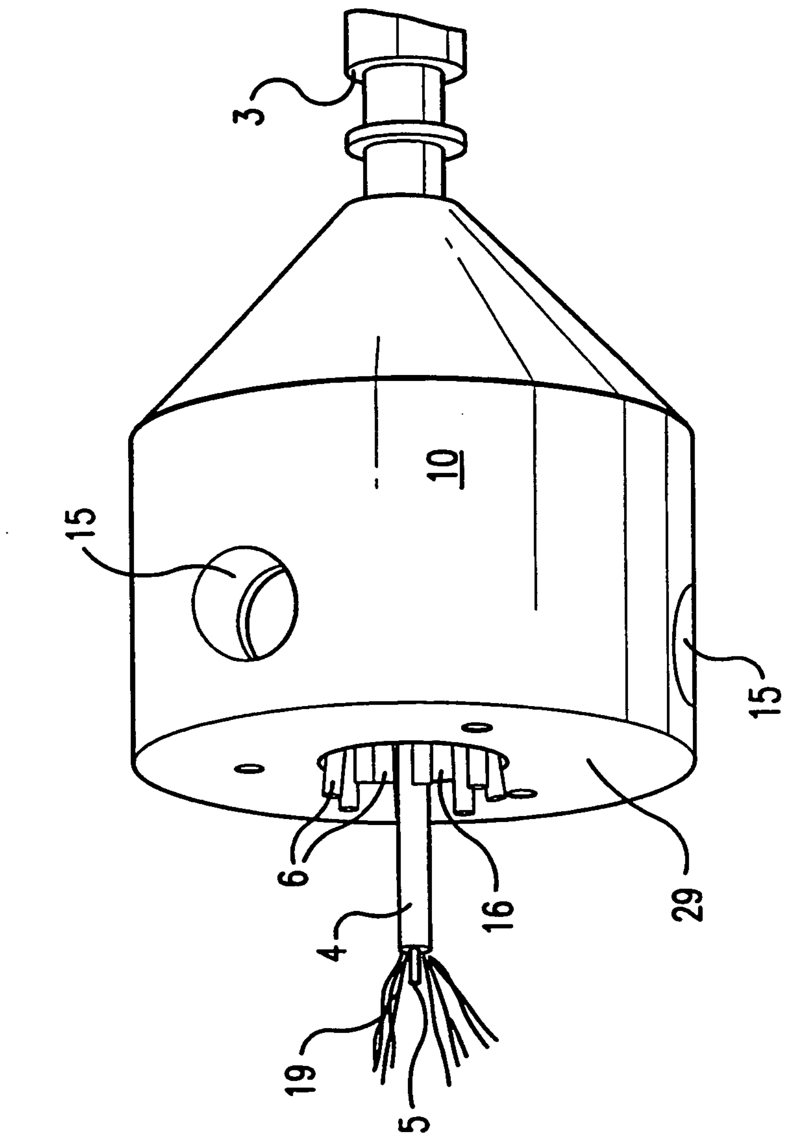


FIG. 4

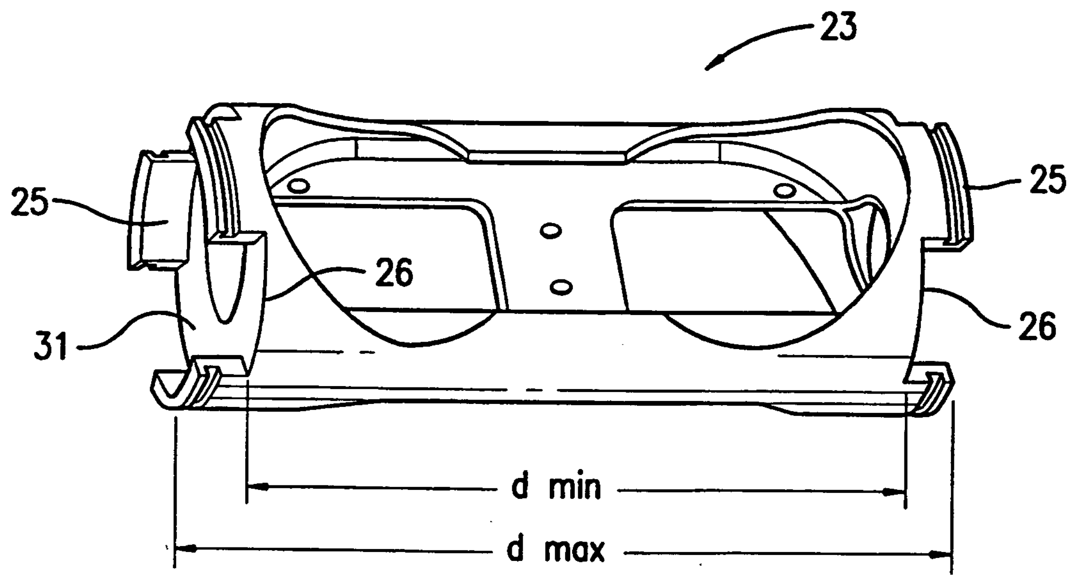


FIG.5



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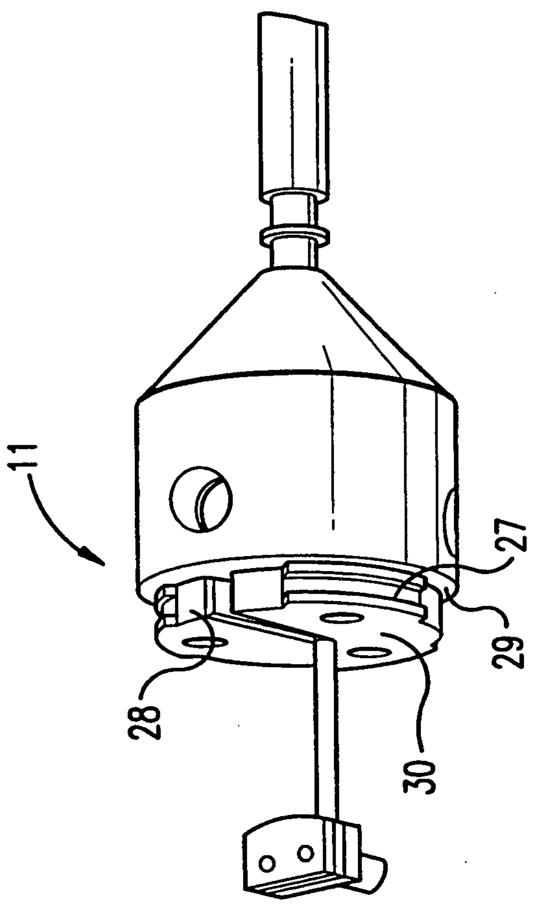


FIG. 6

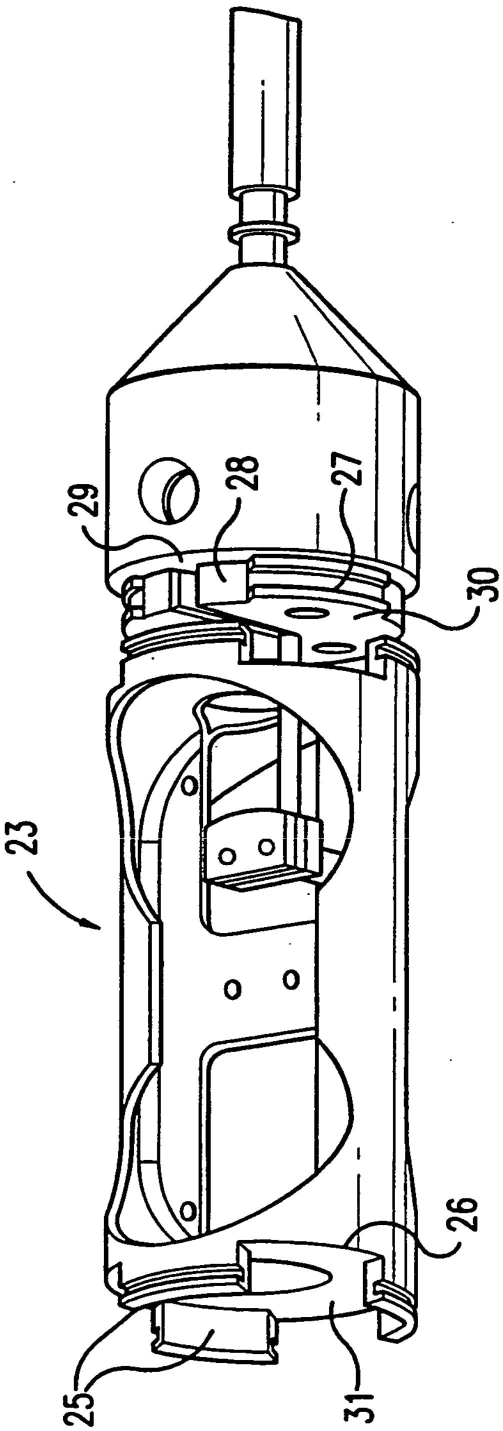


FIG. 7



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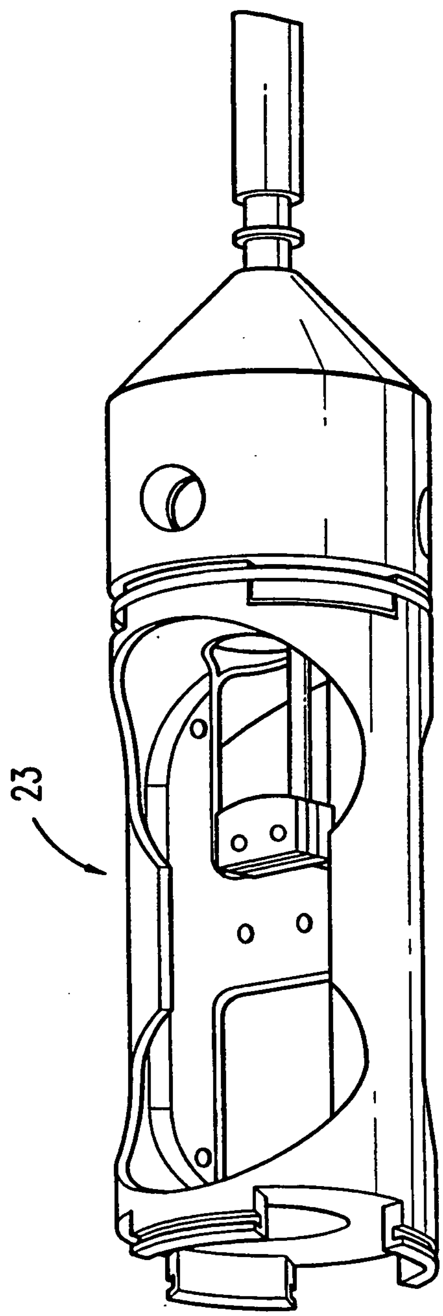


FIG. 8

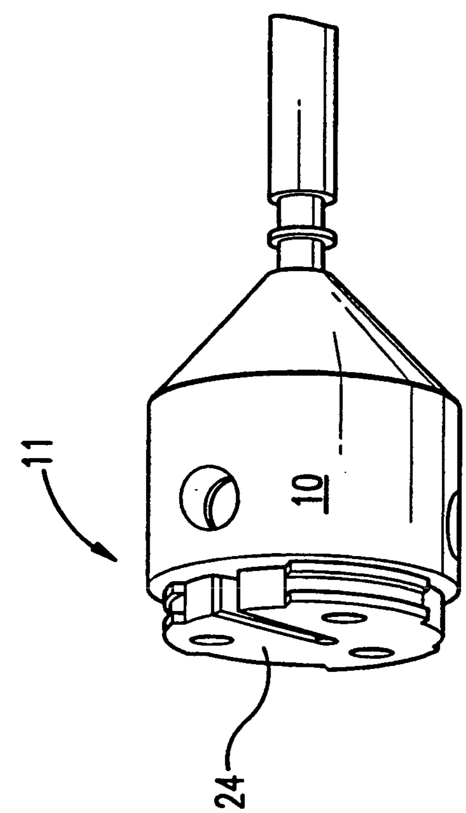


FIG. 9



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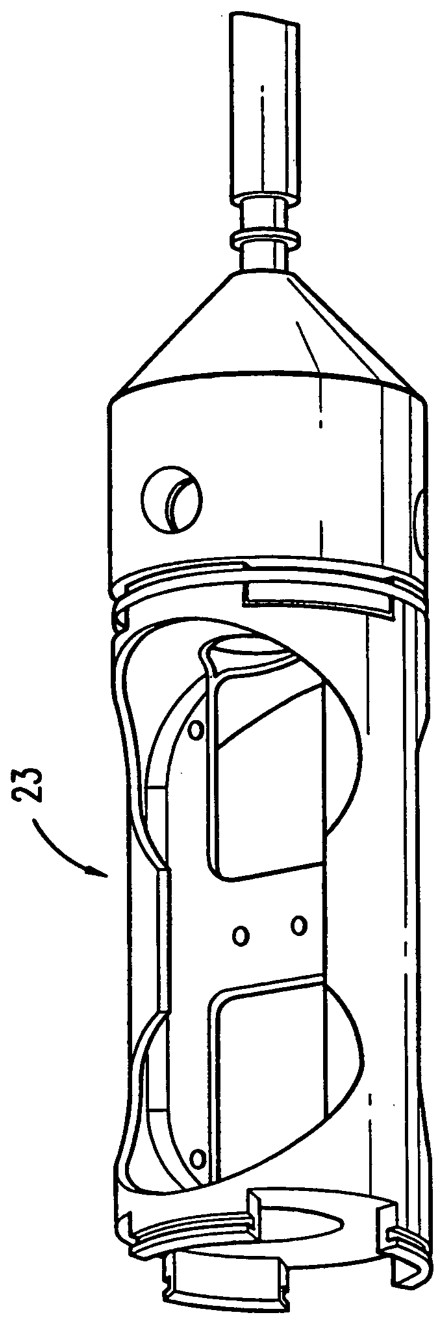


FIG. 10



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OIPE JC25 JUL 0 6 2004 PATENT & TRADEMARK OFFICE

# INTERNATIONAL SEARCH REPORT

International application No.
PCT/US97/18118

**A. CLASSIFICATION OF SUBJECT MATTER**

IPC(6) :GO2B 6/00
US CL : 385/139, 137, 135
According to International Patent Classification (IPC) or to both national classification and IPC

**B. FIELDS SEARCHED**

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 385/139, 137, 135, 136, 138

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

fiber optical cable((9a)joint and ((socket(3a)assembly or socket(3a)assemblies)) and casing and fastener#

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

| Category* | Citation of document, with indication, where appropriate, of the relevant passages | Relevant to claim No. |
|---|---|---|
| A | US 4,252,405 A (OLDHAM) 24 FEBRUARY 24 1981 (24.02.81) SEE FIG. 1 AND ENTIRE DOCUMENT | |
| A, E | US 5,684,911 A (BURGETT) 04 NOVEMBER 1997 (11.04.97) SEE FIG. 1 AND ENTIRE DOCUMENT | |
| A | US 5,481,639 A (COBB ET AL) 02 JANUARY 1996 (02.01.96) SEE FIG. 1 AND ENTIRE DOCUMENT | |

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search

20 NOVEMBER 1997

Date of mailing of the international search report

02 DEC 1997

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